

In cooperation with the Wyoming Department of Agriculture (WDA) and the Wyoming Department of Environmental Quality (WDEQ) with assistance from the Sheridan County Conservation District and the Sheridan County Weed and Pest District

Pesticides in Ground Water - Sheridan County, Wyoming, 1999-2000

In 1991, members of local, State, and Federal governments, as well as industry and interest groups, formed the Ground-water and Pesticide Strategy Committee to prepare the State of Wyoming's generic Management Plan for Pesticides in Ground Water. Part of this management plan is to sample and analyze Wyoming's ground water for pesticides. In 1995, the U.S. Geological Survey, in cooperation with the Ground-water and Pesticide Strategy Committee, began statewide implementation of the sampling component of the State of Wyoming's generic Management Plan for Pesticides in Ground Water. In 1999, baseline monitoring began in Sheridan County.

PESTICIDES IN GROUND WATER

Synthetic organic pesticides are used to control weeds, insects, and other organisms in a wide variety of agricultural and nonagricultural settings. The use of pesticides has helped to make the United States the world's largest producer of food (Barbash and Resek, 1996). Pesticide use, however, has also been accompanied by concerns about potential adverse effects on the environment and human health. A potential pathway for the transport of pesticides is

through hydrologic systems, which supply water for both humans and natural ecosystems. Water is one of the primary ways pesticides are transported from an application area to other locations in the environment (fig. 1) (Barbash and Resek, 1996).

Pesticide contamination of ground water is a national issue because of the widespread use of pesticides, the expense and difficulty of remediating ground water, and the fact that ground water is used for drinking water by about 50 percent of the Nation's population.

Concern about pesticides in ground water is especially acute in rural agricultural areas where over 95 percent of the population relies upon ground water for their drinking water (Solley and others, 1998), although application rates and the variety of pesticides used may be greater in urban areas.

WYOMING'S PESTICIDE MANAGEMENT PLAN

The Ground-water and Pesticide Strategy Committee (GPSC) has developed the generic State Management Plan for Pesticides in Ground Water for the State of Wyoming (SMP) (Wyoming Ground-water and Pesticides Strategy Committee, 1999). The SMP is required by the U.S. Environmental Protection Agency in order for individuals and organizations to continue using certain pesticides in Wyoming. The SMP includes information relating to individuals and organizations involved with the implementation of the SMP, methods of preventing ground-water contamination, ground-water monitoring, and what the responses will be if pesticides are detected in ground water.

One critical part of the SMP is ground-water monitoring. The ground-water monitoring program has two phases. The first phase involves baseline monitoring, which is an initial survey of pesticides in a county's ground water. The second phase is problem identification monitoring, which is used to gather more information about the ground water near wells with significant pesticide detections.

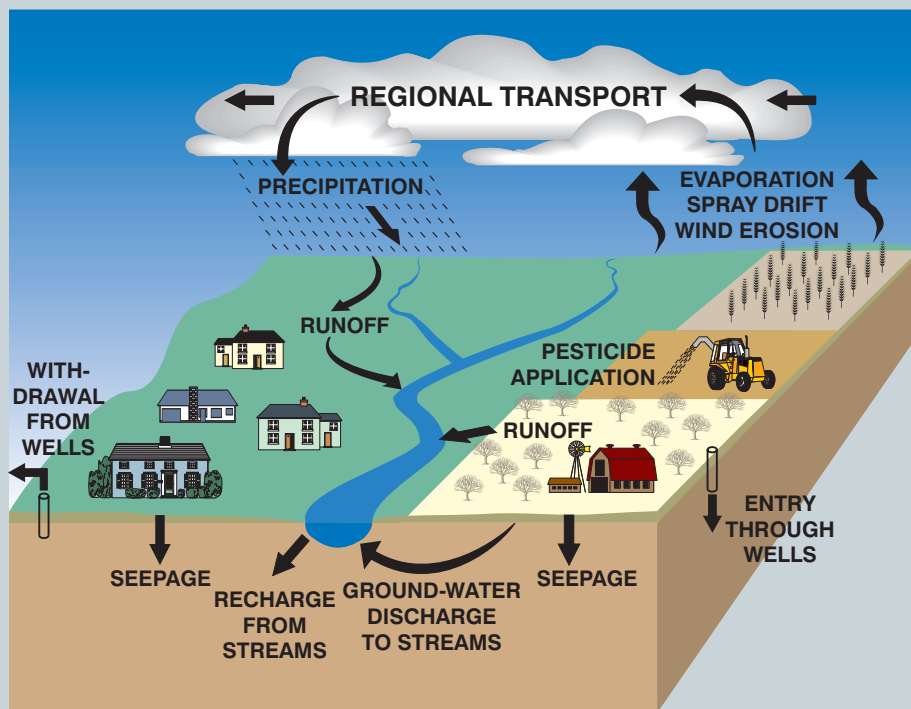


Figure 1. Pathways of pesticide movement in the hydrologic cycle (modified from Barbash and Resek, 1996).

Table 1. Baseline monitoring for pesticides in Sheridan County, late summer 1999 and spring 2000.[$\mu\text{g/L}$, micrograms per liter; NA, not applicable; E, estimated]

Pesticide	Pesticide trade name	Pesticide action ¹	Number of detections/ number of samples ²	Laboratory minimum reporting limit ³ ($\mu\text{g/L}$)	Maximum concentration ($\mu\text{g/L}$)	Average concentration of detections ($\mu\text{g/L}$)	Safe drinking water standard ⁴ ($\mu\text{g/L}$)
Focal pesticides detected in Sheridan County ground water							
Atrazine	Aatrex	Selective herbicide	3/30	0.001	0.009	0.006E	3
Dicamba	Banvel	Herbicide	1/30	0.04	1	NA	⁵ 200
Picloram	Tordon	Systemic herbicide	4/30	0.05	12	5.4	500
Simazine	Princep	Selective herbicide	2/30	0.005	0.07	0.04	4
Tebuthiuron	Spike	Herbicide	1/30	0.01	0.01	NA	⁵ 500
Non-focal pesticides detected in Sheridan County ground water							
Prometon	Pramitol	Non-selective herbicide	13/30	0.02	0.06	0.02E	⁵ 100
Focal pesticides not detected in Sheridan County ground water							
2,4-D Alachlor	Aldicarb Aldicarb Sulfone ⁶	Aldicarb Sulfoxide ⁶ Bromacil		Clopyralid Cyanazine	DCPA Hexazinone	Metolachlor Metribuzin	Telone
Focal pesticides not analyzed in Sheridan County ground water (no method of analysis available)							
		Difenzoquat		Metsulfuron			

¹Meister (1996)²Each of the 15 wells was sampled twice.³The laboratory minimum reporting limit is the lowest concentration at which a pesticide concentration can be quantified without estimation.⁴EPA Maximum Contaminant Level unless otherwise noted (U.S. Environmental Protection Agency, 1996).⁵EPA Lifetime Health Advisory Level (U.S. Environmental Protection Agency, 1996).⁶Degradation product of Aldicarb.

Baseline monitoring is prioritized by a county rank and the vulnerability of the county's ground water to pesticides. During the development of the SMP, the GPSC evaluated each county in Wyoming to determine the potential vulnerability of the county's ground water to pesticides. Each county was ranked based on the extent of cropland and urban areas in the county, as well as the amount of pesticides sold within the county in 1991 (Wyoming Ground-water and Pesticides Strategy Committee, 1999).

A ground-water vulnerability map was prepared for the uppermost or shallowest aquifer by the University of Wyoming Spatial Data and Visualization Center. A Geographic Information System was used to overlay seven layers describing hydrogeology and land use. The map was used to assist in the selection of monitoring sites in each county. The monitoring focuses on areas where the ground water is most vulnerable.

The GPSC selected 18 pesticides (focal pesticides) and 2 degradation products to be sampled as part of the SMP (table 1). The chemical analysis used to detect the focal pesticides can also detect 66 other pesticides and degradation products. Any additional pesticides detected are listed in table 1 as non-focal pesticides. Ground water from all wells in the baseline monitoring program was analyzed for the pesticides listed in table 1, with the exception of difenzoquat and metsulfuron, for which analytical methods were not available.

The goal of the ground-water sampling part of the SMP is to collect ground-water samples for pesticide analyses in all 23 Wyoming counties. To date, sampling has been completed in Goshen (1995-96), Park (1997), Washakie (1997-98), Fremont (1998-99), Lincoln (1998-99), Laramie (1998-99), Big Horn (1999-2000), Sheridan (1999-2000), Platte (2000-01), Johnson (2000-01), and Crook (2000-01) Counties. Sampling is currently being conducted in

Natrona, Sweetwater, and Teton Counties.

GROUND-WATER MONITORING IN SHERIDAN COUNTY

The ground water in Sheridan County was ranked eighth most vulnerable to pesticide contamination in Wyoming (Wyoming Ground-water and Pesticide Strategy Committee, 1999). The vulnerability map for Sheridan County (fig. 2), created by the Spatial Data and Visualization Center (Hammerlink and Arneson, 1998), identifies shallow alluvial and terrace deposits and some of the high mountain areas as the most vulnerable in the county. The high mountain areas were not sampled, as pesticides are rarely used in those areas.

Fifteen wells were selected for baseline monitoring in Sheridan County (fig. 3). All wells were located in Quaternary alluvial and terrace deposits deemed most vulnerable (shown in red

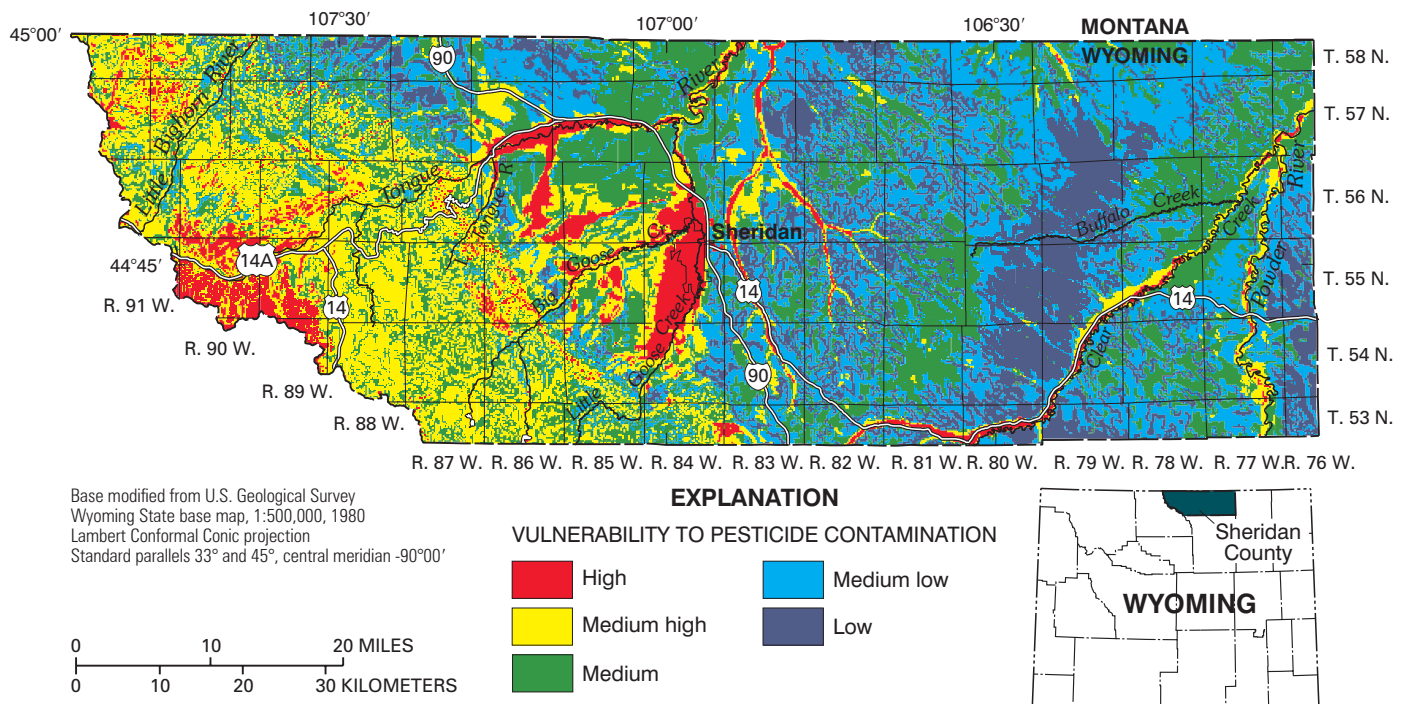


Figure 2. Vulnerability of Sheridan County ground water to pesticide contamination (from Hammerlink and Arneson, 1998).

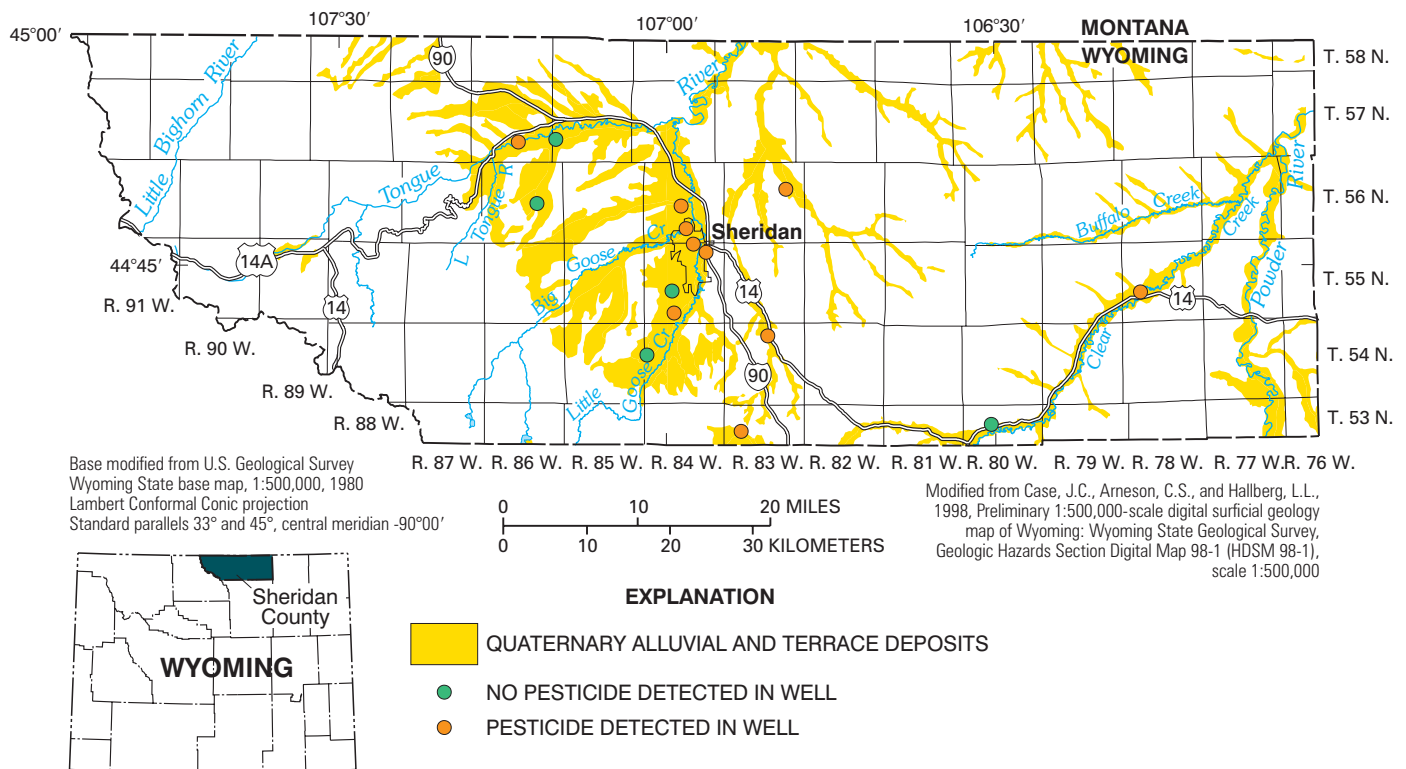


Figure 3. Location of wells sampled in Sheridan County, Wyoming, and notation of pesticide detection in each well.

on fig. 2). The wells were selected with the assistance of the Sheridan County Weed and Pest District, the Natural Resources Conservation Service, and the Sheridan County Conservation District. All wells were sampled twice, in late summer 1999, and spring 2000.

Five of the 18 focal pesticides and 1 non-focal pesticide were detected in Sheridan County. At least one pesticide was detected in 10 of the 15 wells sampled in the county. The concentrations of each pesticide detected were never more than 1/40 of the applicable drinking-water standard (table 1) (U.S. Environmental Protection Agency, 1996; Wyoming Department of Environmental Quality, 1993).

The most commonly detected pesticide in Sheridan County was prometon. Prometon is the active ingredient in Pramitol. Prometon is a general-use pesticide and its detection is typically associated with urban land use (Barbash and others, 1999). This is different from the other counties where baseline monitoring has been completed, as either atrazine (in Goshen, Park, Washakie, Fremont, Laramie, and Big Horn Counties) or picloram (Lincoln County) was the most commonly detected pesticide.

The second most commonly detected pesticide (4 detections in 30 samples), and the pesticide detected with the highest concentration was picloram. A concentration of 12 micrograms per liter (parts per billion) was detected in one well. This is the highest concentration of picloram detected in the state during this sampling program to date. Picloram is the active ingredient in the herbicide Tordon, and is one of the most commonly used pesticides in Wyoming.

DATA DISTRIBUTION AND AVAILABILITY

The sampling results have been given to local groups interested in pesticides in ground water in Sheridan County. The information can be used by citizens and local governments to help understand current conditions. Analytical results of Sheridan County sampling can be found in Mason and others, 2001, and Swanson and others, 2000. Analytical results and fact sheets for all counties sampled to date are available from the U.S. Geological Survey in Cheyenne either by phone, email, or the internet (<http://wy.water.usgs.gov/projects/pesticide/index.htm>).

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